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NUCLEAR INTERACTIONS AT COMPUTATIONS OF THIN SHIELDINGS FROM PROTONS

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SUMMARY

An estimate is made of the contribution of secondary neutrons and γ - rays, generated in the shielding, to the midtissue biological dose behind a plane aluminum shielding.

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* *

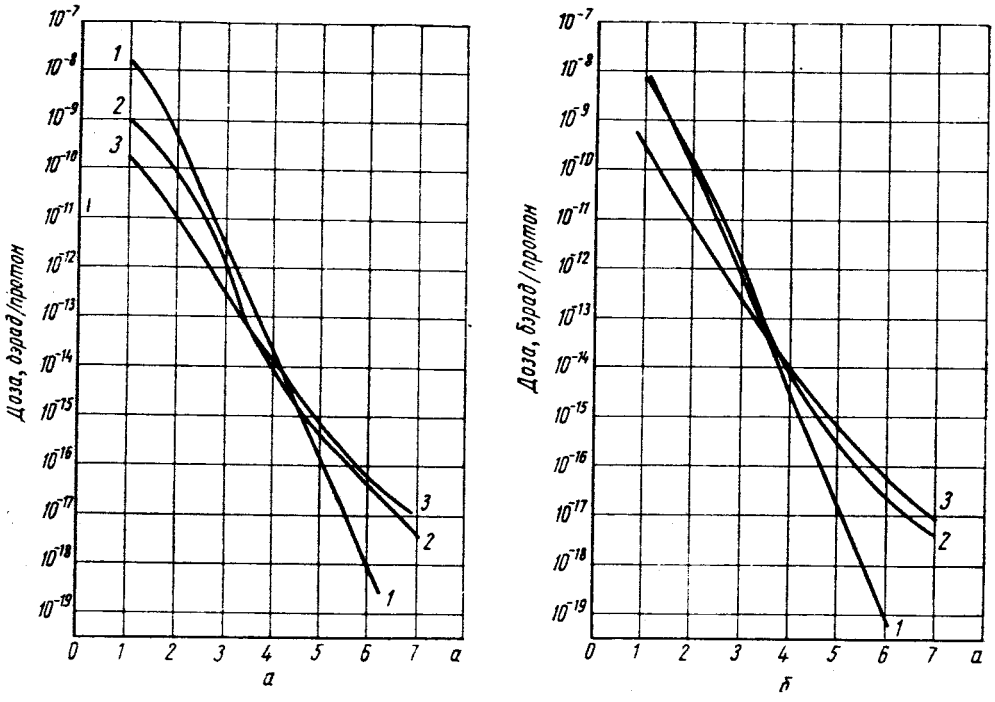
The energy distribution of primary protons, perpendicularly incident upon a plate, is written in the form

$$dN^{o}_{p}/\,dE^{o}_{p} = A\,(a)\,(E^{o}_{p})^{-a},$$

where A (a) is a factor normalizing the incident spectrum to the unity; E^{o}_{p} is the energy of protons, varying in the range 1 — 1000 Mev. The considered interval of a and E^{o}_{p} includes all the proton sources offering a practical interest. Because of insufficiency of data on elementary processes, the calculations were conducted with a series of simplifications. The inelastic collision cross section of a proton with the Al^{27} nucleus at proton energy < 5.8 Mev [reaction (p, n) threshold] was estimated according to compound-nucelus model, and the inelastic collision cross section in the 6 — 10 Mev range was found by interpolation. The calculations were conducted in the single interaction approximation, that is, the shielding was estimated to be sufficiently thin. The number of secondary neutrons and their spectrum were determined for certain values of effective energies of protons. The energy yield by compound-nucleus to γ -radiation for $E_p < 6$ Mev was assumed equal to 1.1 Mev, and for $E_p > 25$ Mev — to 12 Mev; for intermediate energies it was found by interpolation.

* YADERNYYE VZAIMODEYSTVIYA PRI RASCHETE TONKIKH ZASHCHIT OT PROTONOV.

The results of calculations are plotted in the figure below. It may be seen, that as a increases, that is, as the degree of "softness" of the spectrum increases, the share of secondary processes increases sharply.



Mean tissue doses behind an aluminum shielding of thickness d equal to 16 (а) and 47 g/cm^2 (б)

1 — D_p (a, d) — dose of primary protons;
2 — D_n (a, d) — dose of secondary neutrons;
3 — D_γ (a, d) — dose of secondary γ — rays.

The computations conducted describe well only the dependence on a of the doses of secondary radiation; their absolute values may be several times greater or smaller than the computed values. It should be noted that at powerful solar flares the biological doses may reach behind the shielding values of the order of several units of rem (berad ?)* and more, and in case of flares with "soft" spectrum, the contribution of the secondary radiation may be substantial even with a shielding 16 g/cm^2 thick.

***** THE END *****

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[*] The equivalent of the Russian term "Berad" could not be found in any of the dictionaries available.

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